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Infrared studies of some analgesic group commercial tablet samples

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The infrared absorption spectra of some analgesic group commercial tablet samples have been recorded in the spectral region 650-5000 cm^{-1}. A comparative study of the infrared spectra of these tablet samples has been carried out. A collection of these spectra is given and many of the observed bands which may be useful in understanding the structural behaviour have been assigned to specific functional group.

1. Introduction

A survey of the earlier literature on the structural studies of analgesic group commercial tablet reveals that very little effort has been made in this direction. From the quality control point of view, a method of analysis of pharmaceutical products containing caffeine, acetylsalicylic acid and phenacetin compounds has been described by Parke *et al* (1951). They have recorded the infrared spectra of these mixtures only in the region 1430-2000 cm^{-1} in $CHCl_3$ solution and by applying Beer-Bouguert's law, concentration of each constituent was predicted. The present paper deals with the measurement of infrared spectra of five analgesic commercial tablet samples, the comparison of their spectra, and the assignment of some common functional groups.

2. Experimental

In the present investigation, five tablets of commercial trade name : aspro, anacin, avedan, saridon, and analgin which show, especially, analgesic behaviour were taken. These tablets of standard make were obtained from the general pharmacists. For their infrared studies, KBr pellet technique was employed. In making the tablet, fixed ratio of the tablet and anhydrous KBr was used for all the samples. All the spectra were recorded on a Hilger infrared spectrophotometer (model H-800) in the region 650-5000 cm^{-1}. A number of spectra were taken for each tablet sample.

3 Results and Discussion

Table 1 lists the reported constituents of these analgesic tablets, whereas figure 1 shows the chemical structure of these constituent compounds. From these structures, it may be realised that due to heavy substitution of methyl,

acetyl, ethoxy, hydroxyl and carbonyl groups, the spectral behaviour of the mixture compounds present in each tablet will be very complex. However, there are some common functional groups in each tablet samples, which may provide some definite clues regarding the nature of the molecular vibrations. In the present case, the magnitude of frequency and its intensity related to a specific functional group in a compound may be affected either by its own inter-

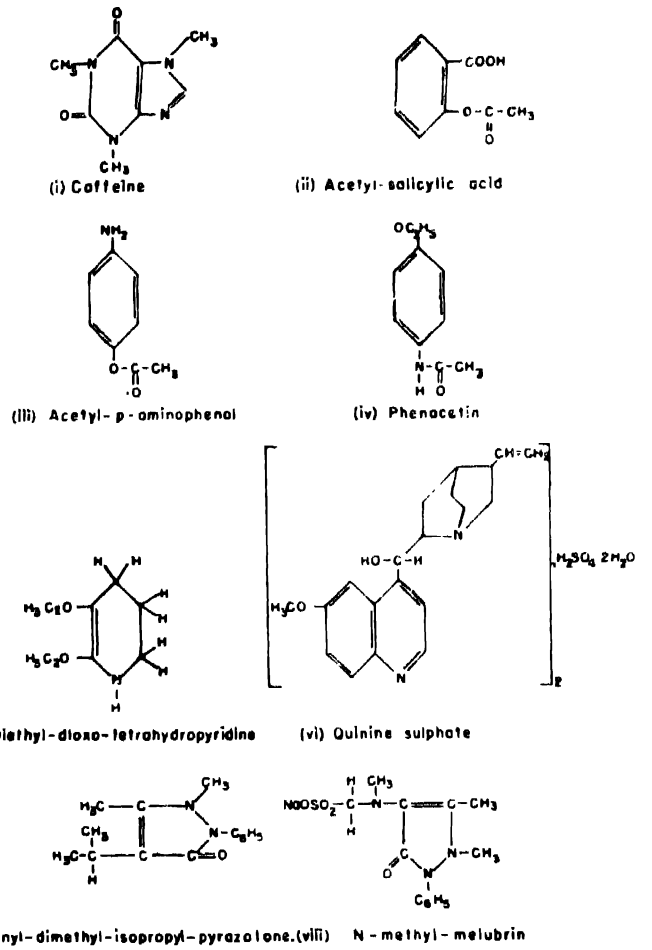

Fig. 1

Fig. 1. The chemical structure of constituent compounds in analgesic tablet samples

and/or intra molecular interaction or by interactions of the molecule of other compounds present in the tablet. Also, the presence of two or more than two types of molecules in one tablet causes superposition of several types of vibration in the overlapping region. Due to this kind of superposition, the assignment of the observed frequencies becomes some what more difficult.

Table 2 lists the stretching frequencies alongwith relative intensities corresponding to the common functional groups observed in figure 2. The spectral range of these stretching frequencies are very well known and can be identified easily (Bellamy 1954, Lal 1971, Lal *et al* 1972). Here only stretching mode have been considered because these modes are expected to have greater transition probability than their deformation modes. It is evident from Table 2 that most of these frequencies appear with appreciable intensity. However, the stretching frequencies belonging to O-H and C-H (in phenyl ring) are not well defined. Due to inter molecular hydrogen bonding (Shoppard 1959), the O-H stretching frequency has been identified as indicated in Table 2. We also infer from the spectra the absence of hydroxyl group in both saridon and analgin. Fig. 2 shows that the stretching frequencies listed in Table 2 except O-H and C-H bonds are not much affected either by the molecular interactions or by the superposition.

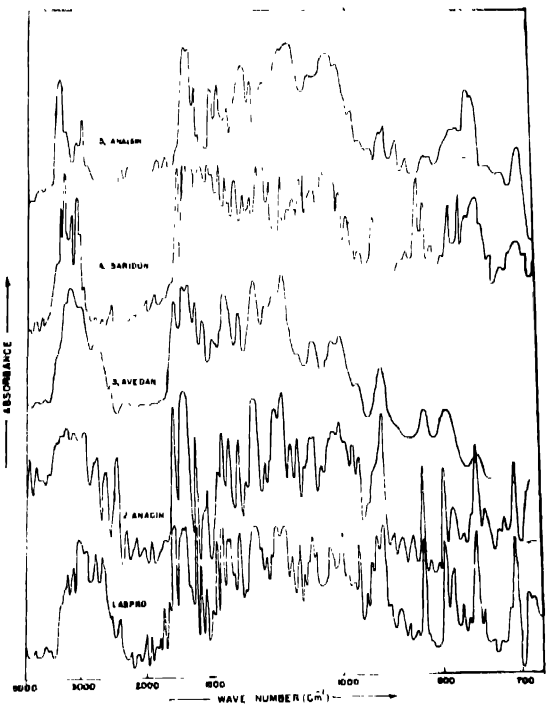

Fig. 2. Infrared spectra of analgesic tablet samples.

The C=O stretching frequency is normally observed in the region 1630-1850 cm^{-1}. In the present study, the C = O groups involved in the constituent compounds of the tablet samples are mainly attached to the acetyl and amide groups. In case of acetyl group, the C = O stretching frequency is observed near 1740 cm^{-1} (overend and Scherer 1960) and in amides it appears in the region

1630-1680 cm^{-1} (Richards and Thompson 1947). As evident from Table 1 and Fig. 1, in analgin C = O group is attached with the secondary amide whereas in aspro, anacin and avedan it is associated with amides and acetyl groups both, while acetyl groups are dominent. As in these acetyl groups, an electron withdrawing phenyl group is placed on the single bonded oxygen, the carbonyl frequency will be raised. Thus the strong bands at 1640 cm^{-1} in analgin and around 1740 cm^{-1} in aspro, anacin and avedan has been attributed to C = O stretching mode. In case of saridon, in addition to amides and acetyl groups of earlier three tablets, a secondary amide group is also attached with the carbonyl. In amides the dominent effect is the mesomeric effect which results a weaker C = O bond and lowering of its stretching frequency. Consequently, with combined effect of acetyl amides groups, the C = O stretching frequency in saridon has been identified at 1680 cm^{-1}.

Table 1. Commercial tablets and their reported constituents

Tablets	Constituent compounds (Reported)
Aspro	Caffeine, and acetylsalicylic acid*.
Anacin	Caffeine, acetylsalicylic acid*, and quinine sulphate
Avedan	Caffeine, acetylsalicylic acid*, and acetyl-p-aminophenol
Saridon	Caffeine, Phenacetin, Phenyl-dimethyl-isopropyl pyrazolone, and Diethyl-dioxo-tetra-hydropyridine**.
Analgin	Novalgin (N-methyl-melubrin***).

*Acetylsalicylic acid is also known as Aspirin.
**Diethyl-dioxo-tetrahydropyridine may also be called as Diethoxy-tetrahydropyridine
***Melubrin is Sodium-antipyrine-amino-methanesulfonate.

From theoretical calculation (Herzberg 1945), C-C stretching mode is predicted at around 900 cm^{-1}. When three hydrogen atoms are associated with one of the two carbon atoms i.e., C-CH_3, due to increase in mass, the C-CH_3 stretching mode is expected to be lower than C-C stretching frequency. Based on this principle, C-CH_3 stretching frequency has been assigned at 785 cm^{-1} in case of toluene (Pitzer & Scott 1943) and at 753 cm^{-1} in case of O-fluorotoluene (Joshi & Singh 1967). Thus, our assignment of C-CH_3 stretching mode around 800 cm^{-1} as shown in table 2 seems reasonable.

The different kinds of base matrices, if any, from one type to other type of tablet can be deduced by comparing these spectra. Further work towards evolving a new method for quality control of such type of analgesic tablets and determining the adulterant, if any, is in progress and will be presented elsewhere.

Table 2. Stretching modes of common functional groups in the tablet

Aspro	Anacin	Avodan	Saridon	Analgin	Assignment
		Frequencies (cm^{-1}) & their relative intensities			
3290 m	3224 m(br)	3252 w		-	O-H stretching
3108 m 3049 vs	3024 mw	3100 vs 2972 sh	3112 sh 3024 s	3050 m 2990 sh	C-H stretching in phenyl group
2843 s 2735 sh 2675 s	2798 mw 2647 sh 2590 ms	2787 mw 2639 mw	2890 s 2771 sh 2675 w	2847 ms 2766 sh 2690 sh	C-H stretching in in CH_3 group
1740 vvs	1743 vs	1738 s	1680 vvs	1640 vvs	C — O stretching
1667 vs	1644 vs	1672 vs	1638 vvs	1612 vvs	C = C stretching
1590 vs	1580 s	1644 vs	1596 vvs	1570 s	C = C stretching
1560 s	1516 ms	1595 s	1541 vvs	-	C = C stretching
1204 vs	1201 s	1204 sh(br)	1160 vs	1178 vvs	C-N stretching
1175 vs	1175 vs	1186 vs	--	---	C-OH stretching
795 vs	795 s	825 m	775 s	769 ms	C-CH_3 stretching
747 vs	747 s	788 m(br)	741 s	752 s	N-CH_3 stretching
737 ms		741 mw	737 s	745 s	N-CH_3 stretching

m, medium ; ms, medium strong ; mw, medium weak ; s, strong ; vs, very strong ; vvs, very very strong ; w, weak intensities ; sh, shoulder ; br, broad.

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